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# Methodology of Recent Solid Waste Stream Assessments and Summary of Current Recycling Endeavors at Lawrence Livermore National Laboratory (LLNL)

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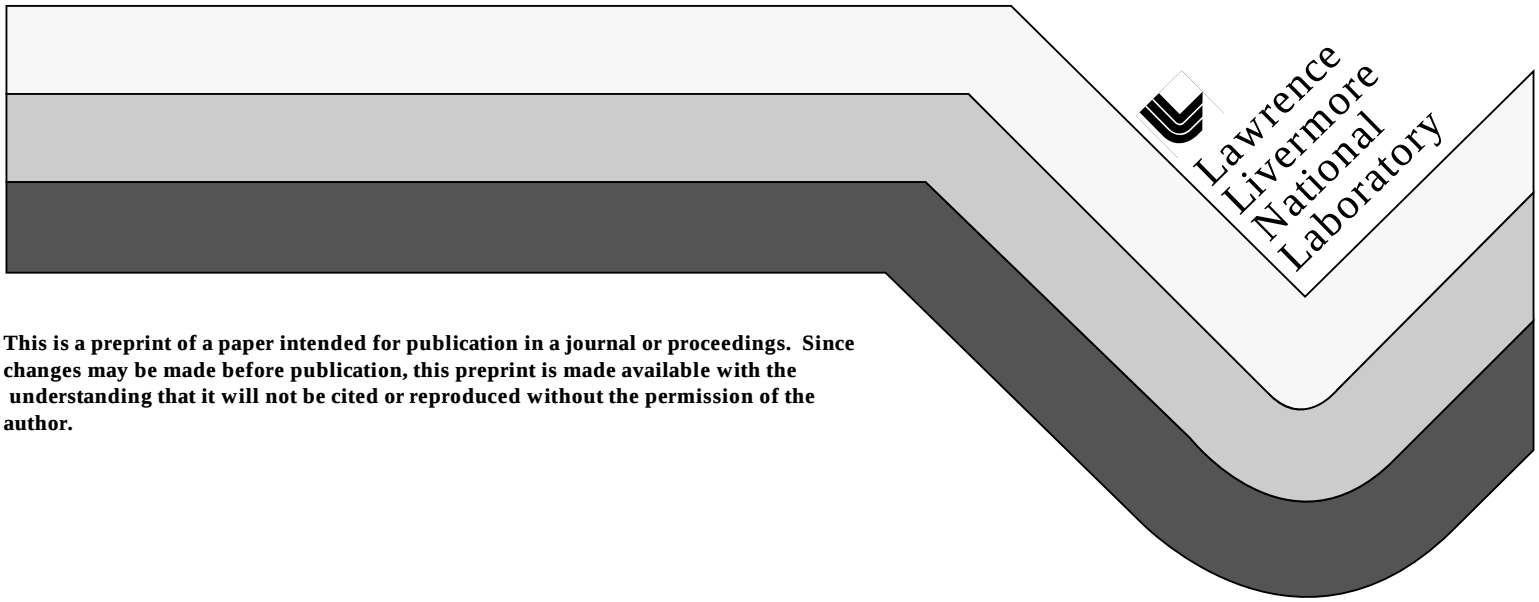

# Methodology of Recent Solid Waste Stream Assessments and Summary of Current Recycling Endeavors at Lawrence Livermore National Laboratory (LLNL)

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**Abstract/Executive Summary**

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**Work Site:** Lawrence Livermore National Laboratory (LLNL), Livermore, CA, Site. LLNL is operated by the University of California for the Department of Energy. The LLNL-Livermore site is approximately 1 square mile with several hundred facilities and approximately 10,000 employees (full-time and contract).

**Importance/Significance:** Solid Waste Stream Assessments determine the components of given waste streams. An evaluation of findings from the assessments allows components to be targeted for effective source reduction, reuse, or recycling.

**Testing Methods:** LLNL assessed 10 percent of its onsite dumpster locations (25 of 250). Dumpsters were selected based on location and surrounding facility use. Dumpster contents were sorted according to type into containters. The filled containters were then weighed and photographed. The information was noted on field tabulation sheets. Dumpster locations, date of sort, sort categories, weight, and cubic yardage were entered into a database for review and tabulation.

**Results:** LLNL sorted approximately 7000 pounds of waste in each of the two assessments. A high incidence of cardboard (uncompacted) was present in most dumpsters. A high incidence of polystyrene was also present at dumpsters serving the LLNL cafeterias. Very little glass or aluminum was found. Enough waste paper was present to indicate that the paper recycling program needed increased employee awareness and a possible expansion.

**Conclusions:** As a result of the Solid Waste Stream Assessments, LLNL has expanded its cardboard and paper recycling programs and implemented a moving box and a pallet reuse programs. LLNL is also studying a possible recycling program for cafeteria polystyrene and possible program expansions for magazine, newsprint, and glass recycling.

LLNL operates many source reduction/reuse/recycling programs to create an environmentally responsible organization and meet federal, state, and local waste diversion mandates. Many of these

programs were developed as a result of the solid waste stream assessments conducted at LLNL.

## 1 Background

The Pollution Prevention Group (PPG) of Lawrence Livermore National Laboratory (LLNL) conducted Solid Waste Stream Assessments in late 1992 (August–October) and in early 1993 (March–May). From these assessments, we obtained a comprehensive understanding of the composition of the LLNL solid waste stream. The results of the assessments provided us with an exceptionally important tool in planning future source reduction, reuse, and recycling programs at LLNL.

LLNL occupies a 1-square mile area near Livermore, California. Approximately 10,000 LLNL employees work in several hundred onsite facilities, including laboratories, offices, and fabrication shops. Refuse collection requires two hundred fifty 4-cubic yard dumpsters. About one-half of the dumpsters are emptied daily; the other half are emptied every other day.

## 2 Objectives

We studied the contents of 25 dumpsters (10 percent) during each assessment. We selected our sample dumpsters based on their geographical location and area/facility use in order to obtain a representative sample of daily solid waste generation.

## 3 Procedure

We examined the contents of three to four dumpsters per day over a one-week period. To assure full dumpsters, we had refuse pick-ups discontinued two days prior to our scheduled sampling. We provided refuse handlers with maps to alert them to study area locations. As an additional reminder, we also placed “no empty” signs on the dumpsters.

For the actual sorting, we chose a remote location equipped with a portable emergency eyewash and a transportainer for storing tools and supplies. The sample dumpsters were brought to the site in succession, and their contents dumped on large tarps. The four- to five-person sorting crew used rakes, shovels (snow type), and hooked weeding tools to minimize refuse handling. They wore safety shoes, safety glasses, standard leather gloves (outer layer), and surgical gloves (inner layer). Soap and water were available for frequent washing.

We used the following sorting categories: aluminum, bi-metal (cans), metal shavings, other metal (by type), cardboard, cloth, food, glass, mixed plastic, polystyrene, rubber, wood, and paper (by type). Paper types were white office, colored, coated, paper towels, brown bags, and newsprint.

After sorting the contents into categories, we weighed and photographed the filled sort cans. Net weights and volumes were recorded on field tabulation sheets (see Table 3.1). For easy

conversion, we developed a chart that converted sort can fullness to volume. The daily field data was transferred from the field tabulation sheets to an electronic spreadsheet.

## 4 Discussion

Over 7,000 pounds (60 cubic yards) of waste were sorted in each assessment. Some of our findings from the assessments were surprising. We had expected plastics to be large contributors to the LLNL solid waste stream. We found, however, that most types of plastic were actually low contributors. Only polystyrene was prevalent in dumpsters serving our three onsite cafeterias. There was a high incidence of paper products (especially cardboard), but only small amounts of glass, aluminum, and wood. Newsprint (ONP) and magazines (OMG) were found in significant enough quantities to warrant the establishment of a limited recycling program. Based on our results, we concluded that a waste stream assessment is an important step in the waste reduction planning process.

## 5 Results

Many of the programs discussed below were developed or validated as a result of these LLNL Waste Stream Assessments.

LLNL operates several source reduction/reuse/recycling programs to achieve two purposes. First, such programs contribute to LLNL's environmental responsibilities; and second, they meet federal, state, and local waste diversion mandates.

The success of these efforts is evident in the fact that in 1995 LLNL diverted 25 percent of its 12,424 tons of solid waste to reuse or recycling. The Laboratory's programs include paper, cardboard, metal, and wood recycling; composting; and equipment reuse and salvage operations. Reuse/recycling programs include excess prepared food donations, rechargeable batteries and battery recycling, and printer toner cartridges recycling and reuse.

### 5.1 Participation by LLNL Organizations

These recycling/reuse/recovery programs require the participation of all LLNL staff and the support of LLNL management. It is Laboratory policy to purchase, wherever possible, items that use recovered material, such as photocopy paper, moving boxes, printing paper, and retread tires.

PPG is one of the several organizations central to making recycling/reuse a reality at LLNL. In addition to sponsoring the Solid Waste Stream Assessments, PPG also spearheads the LLNL employee awareness program that includes new-employee orientation, articles in the employee newspaper, poster distribution, a speakers bureau, Earth Day sponsorship, and an

environmental hotline. Employees who have questions, suggestions, or information regarding LLNL source reduction, reuse, or recycling programs call EARTH (or extension 3-2784). PPG staff respond the same day.

Each year PPG organizes an Earth Day exposition that showcases environmental technologies, local recycling agencies, composting, solar power, pollution prevention, energy management, water conservation, and companies featuring products manufactured with recovered content.

To track waste generation and recycling program performance economically, the PPG staff developed an online tracking database. The flexible design of the database easily accommodates data from new recycling/reuse programs.

Other LLNL departments that are active in the Laboratory's reuse/recycling programs include the LLNL Transportation Department; the Donation, Utilization, and Sales (DUS) Group; and the Plant Engineering Department. The Transportation Department picks up and delivers recyclable materials to a DUS facility.

The DUS Group operates many of the recovery/reuse/recycling services, including ferrous/nonferrous metal and cardboard recycling and reuse of wooden pallets, moving boxes, and equipment. In 1995, the DUS Group diverted almost 1,687 tons of material from LLNL solid waste stream. This did not include material diverted to reuse/reassignment programs.

The Plant Engineering Department operates a pilot battery recycling program. Even LLNL's gardeners and its cafeteria operator have recycling programs.

### 5.2 Paper/Phone Book/Cardboard/Magazine Recycling

In 1995, LLNL recycled approximately 369 tons of paper. The full-site paper recycling program has over 110 facility collection points. It accepts white and colored ledger paper; white paper with recycled content; letterhead paper; miscellaneous white paper; typing, fax, and computer printout paper; LLNL phone books; and manila file folders. Two to three times a week during swing shift, a vendor picks up discarded paper from collection bins (seven bins per pickup). At the vendor's offsite facility, the paper is shredded and recycled for such uses as toilet paper and egg crate cartons.

Classified paper has a separate handling system and is hammer milled onsite for recycling.

The DUS Group operates a separate recycling program for accumulated quantities of external, non-LLNL phone books.

The cardboard recycling program covers the entire Livermore site with 115 collection locations. Cardboard is picked up weekly and transported to the DUS facility where it is baled for sale, utilizing a commercial-size baler. This program diverts approximately 5-10 tons of material per week from LLNL's solid waste stream.

LLNL has established two programs for recycling magazines and newspapers. Small quantities of magazines and newspapers can be dropped off at special bins. Larger quantities of undeliverable magazine and uncirculated newspapers (including LLNL's onsite *Newsline*) are transported to the DUS Group facility where they are recycled through a local vendor. In 1995, this program diverted 11 tons of material from the LLNL waste stream. LLNL is now considering expanding the program using its commercial-size baler.

### 5.3 Wood Recycling

Since July 1993, unusable wood—such as broken pallets and demolition wood scraps—has been sent to a designated collection yard where a vendor picks it up for recycling. In 1995, this program diverted 406 tons of material from the LLNL solid waste stream.

### 5.4 Plant Clippings/Composting/Christmas Tree Recycling

LLNL gardeners routinely compost plant and tree clippings for use as soil amendments onsite. Not only does this program divert large amounts of plant material from the Laboratory's solid waste stream but it also represents a cost savings because LLNL now buys less commercial soil amendments.

At Christmas, LLNL gardeners collect discarded holiday trees and process them as part of their composting program.

### 5.5 Community Food Donation

The vendor that operates LLNL's three cafeterias donates excess prepared food to a local food bank for distribution to disadvantaged residents.

### 5.6 Recycling/Reuse and Rechargeable Batteries

LLNL Plant Engineering operates a pilot battery recycling program that accepts alkaline, small lead acid, nickel cadmium, lithium, silver oxide, carbon zinc, and mercuric oxide batteries. Drop-off areas for batteries are located in several buildings onsite. Rechargeable nickel cadmium or alkaline batteries and chargers for nonemergency pagers are available from the Supply and Distribution Department. This battery reuse program saves purchasing and disposal resources.

## 5.7 Printer Toner Cartridge Recycling

LLNL turns over nonhazardous printer and copier toner cartridges to a local vendor for reconditioning. LLNL also purchases reconditioned cartridges at a substantially lower price than that of new cartridges. In 1995, LLNL diverted approximately 3,450 pounds or 2,300 toner cartridges from its solid waste stream through this program.

## 5.8 Salvage/Equipment Reuse Programs

The DUS Group coordinates the reassignment of surplus equipment to other LLNL departments and to federal agencies. One DUS reuse program that benefits local schools is the LLNL Education Program. This program, operating under U.S. Department of Energy guidelines, makes available excess equipment and supplies to California schools.

This work was performed under the auspices of the U.S. DOE by LLNL under contract No. W-7405-Eng-48.

**Table 3.1 Waste Stream Assessment Field Tabulation Sheet**

| | | | |
|---|---|---|---|
| Date: | | Samplers: | |
| Recorder: | | Weigher: | |
| Quad. No.: | | Dumpster No.: | |
| Dumpster Type: | | Total Weight: | |
| Tare Weight: | | Net Weight: | |
| Dumpster Volume: | | | |

| Waste Stream Description | | | | |
|---|---|---|---|---|
| Category | Total Weight | Tare Weight | Net Weight | Comments/ Visual Observations |
| Glass: | | | | |
| Clear | | | | |
| Green | | | | |
| Amber | | | | |
| CA Red. | | | | |
| Paper: | | | | |
| White Office | | | | |
| Colored | | | | |
| Computer | | | | |
| Coated (i.e., magazines) | | | | |
| Newsprint | | | | |
| Cardboard | | | | |
| Plastic: | | | | |
| HDPE | | | | |
| PET | | | | |
| Styrofoam | | | | |
| Oother Foam | | | | |
| PVC | | | | |
| Plastic Film | | | | |
| Other | | | | |
| Metal | | | | |
| Aluminum cans | | | | |
| Steel or Bimetal Cans | | | | |
| Aluminum | | | | |
| Copper | | | | |
| Steel/Iron | | | | |
| Organic | | | | |
| Food Waste | | | | |
| Dirt | | | | |
| Wood | | | | |
| Cloth | | | | |
| Constr. Debris | | | | |
| Concrete | | | | |
| Asphalt | | | | |
| Household Batteries | | | | |
| Hazardous Waste | | | | |
| Paint | | | | |
| Aerosol Cans | | | | |
| Cleaning Compounds | | | | |
| Other | | | | |